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(71) Applicant: NORTHERN TELECOM LIMITED [CA/CA]; World Trade Center of Montreal, 8th Floor, 380 St. Antoine Street West, Montreal, Quebec H2Y 3Y4 (CA).

(72) Inventors: EMERY, Jason, Gerrit; 1001 W. St. Julian Place, Apex, NC 27502 (US). GENTRY, William, David; 103 Carriole Court, Cary, NC 27513 (US).

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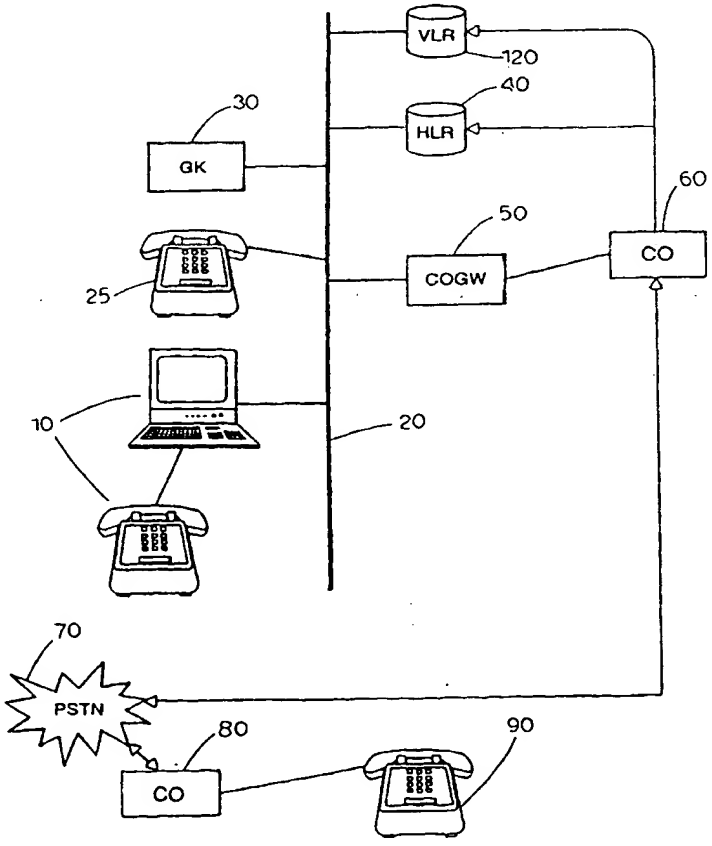
(54) Title: APPARATUS AND METHOD FOR PSTN AND INTERNET TELEPHONY INTEGRATION

(57) Abstract

A system and method of PSTN based network roaming and SCP based subscriber management for internet telephony systems. When a call is incoming to the central office (60) of a subscriber's home service area which supports packet data network telephony (10), such as for instance IP telephony, a home location register (40) translates the directory number into an IP address, URL address, or electronic mail address much the same that a local number portability node re-routes calls from non-IP telephony systems. When a subscriber is roaming in another network (100), the roamed into (visited) gateway (130) signals back to the home location register (40) of the subscriber's network (20) and registers its (i.e., the visited gateway's) public switching telephone network (70) telephone directory number and the IP address assigned to the subscriber while connected to the visited network (100). When subsequent calls are incoming to the subscriber's home network switch, the home location register (40) provides the ten (10) digit directory number of the visited gateway (130) and the new IP address rather than the home gateway telephone number and IP address of the subscriber.



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APPARATUS AND METHOD FOR PSTN AND INTERNET TELEPHONY INTEGRATION

Technical Field

The present invention relates to using a signaling control point to act as a home location register for a wireless or wireline telephone switch that supports internet protocol (IP) telephony.

Background and Related Art

Currently, wireless subscriber profile data is configured in a home location register (HLR). The HLR resides either on a computing module (CM) which is an end office telephony switch or in an off-board node that supports IS-41 protocol signaling. The subscriber data profile is retrieved from the HLR upon registration and stored in a visitor location register (VLR) while the subscriber is actively roaming. By contrast, wireline subscriber profile data, which includes internet (IP) telephones, is stored within the computing module in the form of table data. Wireline subscribers currently do not have public switching telephone network (PSTN) roaming capability.

The present invention addresses several shortcomings of the current configuration. First, the current subscriber profile data in the computing module does not provide the ability to map E.164 telephone directory numbers into internet addresses, e-mail addresses or universal resource locators (URLs) as may be used by IP telephones. Second, current systems have no provision

for wireline mobility because an assumption is made that the address of a wireline is fixed, tied to a physical interface, and only moved by changes to the provisioned tables.

Summary of the Invention

As with standard wireline telephony subscribers, IP telephony subscribers are assigned a standard ten (10) digit E.164 directory number (hereinafter "directory number") comprised of a three (3) digit area code, a three (3) digit exchange within the area code, and a four (4) digit unique extension within the exchange. When a call is incoming to the central office of a subscriber's home service area which supports computer network telephony, such as for instance IP telephony, a signaling control point translates the directory number into an IP address, URL address, or electronic mail address much the same that a local number portability node re-routes calls for non-IP telephony systems. The signaling control point is signaled from an advanced intelligent network (AIN) termination attempt trigger point and provides the directory number of an H.323 gateway and the IP address of the subscriber's H.323 IP telephony end point. If the subscriber has de-registered from the signaling control point, an overflow route to a land line or voice mail is provided.

Local number routing (LNR) fields are re-used with the local number becoming the ten (10) digit directory number of the gateway, and the called directory number (CDN) becoming the IP address, or a new transmission

control application protocol (TCAP) field could be introduced specifically for the IP address.

When a subscriber is roaming in another network, the roamed into (visited) gateway signals back to the home location register / signaling control point of the subscriber's network and registers its (i.e., the visited gateway's) public switching telephone network telephone directory number and the IP address assigned to the subscriber while connected to the visited network. When subsequent calls are incoming to the subscriber's home network switch, the home location register / signaling control point provides the ten (10) digit directory number of the visited gateway and the new IP address rather than the home gateway telephone number and IP address of the subscriber.

This provides the subscriber with a virtual private network for placing telephone calls over IP terminals. Thus, subscribers have the ability to roam among networks and continue placing or receiving telephone calls ubiquitously. The subscriber maintains a single telephone directory number and receives service no matter which IP network he is currently connected to. Under the present invention, subscribers can, for instance, move from a static network connection at work to a dial in network connection from home.

The present invention provides a method of managing call origination for subscribers on a packet data telephony network which includes a home location register. A subscriber registers a packet data communication (IP telephony) device with the home location register of the subscriber's home packet data (IP) network, and uses the home location register to translate the

subscriber's packet data (IP) address into a (E.164) telephone directory number.

The present invention also provides a method of managing call termination (i.e., call reception) for subscribers on a packet data telephony network which includes a home location register. The subscriber registers a packet data communication (IP telephony) device with the home location register of the subscriber's home packet data (IP) network, and uses the home location register to translate the subscriber's (E.164) telephone directory number into a packet data (IP) address.

The present invention further provides a method of public switching telephone network based roaming call origination for IP telephony devices. The subscriber registers his IP telephony device on a remote IP network, and may originate calls from the IP telephony device on the remote network to a third party.

The present invention still further provides a method of public switching telephone network based roaming call termination (i.e., call reception) for IP telephony devices. An IP subscriber registers his IP telephony device on a remote IP network, and may receive calls on the IP telephony device on the remote network from a third party.

It is therefore an object of the invention to provide PSTN based network roaming for IP telephony devices.

It is a further object of the invention to provide SCP based management for IP telephony devices.

Some of the objects of the invention having been stated hereinabove, other objects will become evident as the description proceeds, when taken in connection with the accompanying drawings as best described hereinbelow.

Brief Description of the Drawings

FIGURE 1 is a block diagram illustrating the hardware nodes present in a subscriber's home area network and a link to outside networks;

FIGURE 2 is a block diagram illustrating the hardware nodes required for roaming on a public network;

FIGURE 3 is a block diagram illustrating the hardware nodes required for roaming on a private network.

FIGURE 4 illustrates the method or process steps for subscriber registration within the home area network;

FIGURE 5 illustrates the method or process steps for call origination for a subscriber within the home area network;

FIGURE 6 illustrates the method or process steps for call termination within the home area network;

FIGURE 7 illustrates the method or process steps for subscriber registration while roaming on a remote area network;

FIGURE 8 illustrates the method or process steps for call origination while roaming on a remote area network; and

FIGURE 9 illustrates the method or process steps for call termination while roaming on a remote area network.

Detailed Description

Referring now to **FIGURES 1-3**, a packet data telephony network is shown in each figure. In figures 2 and 3, two (2) packet data telephony networks are shown linked together by a public switching network and a virtual private network, respectively. It is to be understood that multiple (more than two) packet data telephony networks may be linked together. Each network has a number of common elements which include home location registers (HLR) **40**, visitor location registers (VLR) **120**, gatekeepers (GK) **30,110**, gateways (COGW) **50,130**, central offices (CO) **60,140**, and various packet data telephony devices **10,25,35**. Other devices may be connected to the packet data network without departing from the spirit or scope of the present invention.

FIGURE 1 illustrates a home switch call scenario. Registration, call origination, and call termination functions are described for a subscriber utilizing his home network. Registration refers to the process of provisioning the home location register (or the visitor location register if roaming) with the subscriber's relevant data. Call origination refers to placing a call while call termination refers to receiving a call.

Registration is initiated when a subscriber logs into his computer at work. Once the subscriber connects his IP telephone **10** to his home IP network **20**, registration is initiated with a local serving gatekeeper (GK) **30**. Gatekeeper **30** forwards the registration information to a serving home location register (HLR) **40** which validates the subscriber. Home location register **40** responds with authentication data and subscriber profile data which is then stored within

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gatekeeper 30. Home location register 40 stores the directory number (DN) of the central office gateway (COGW) 50, the directory number of the subscriber, and the assigned IP address of the subscriber's IP telephone 10.

Consider a situation in which the subscriber wishes to initiate a call to someone who lives in a different service area. The subscriber's gatekeeper 30 queries his home location register 40 supplying his IP address. Home location register 40 supplies the subscriber's directory number, authentication data and any other data needed to place the call. The subscriber's gatekeeper 30 initiates a call origination via the central office gateway 50 and central office (CO) 60 by supplying the subscriber's directory number as the calling party and called party's directory number. The call routes normally over a public switching telephone network (PSTN) 70 to the called party's serving central office 80.

Now consider the reverse situation in which someone wishes to initiate a call to the subscriber (e.g., call termination). The caller 90 dials the subscriber's telephone directory number. The call routes normally over the public switching telephone network 70 from the caller's central office 80 to the subscriber's central office 60. The subscriber's central office 60 queries home location register 40 by supplying the subscriber's directory number and retrieves the directory number of the subscriber's central office gateway 50 and the IP address of the subscriber's IP phone 10. The subscriber's central office 60 routes the call to the subscriber's central office gateway 50 by supplying the IP address of the subscriber's IP phone 10. Lastly, the subscriber's central office gateway 50 uses the subscriber's IP address to route the call to the

subscriber's IP telephone **10**. Call origination may be optimized by duplicating the IP address to directory number mapping in the gatekeeper.

FIGURE 2 illustrates the architecture necessary to place and receive calls while roaming on a public network. Consider a scenario where a subscriber is out of his home service area. The subscriber registers on a remote network by connecting to the remote network **100** and initiating contact with the remote network's gatekeeper **110** in which the subscriber supplies his home area directory number. The remote gatekeeper **110** receives the registration request and recognizes it as a non-local subscriber based on the supplied directory number. The remote gatekeeper **110** then forwards the request to a visitor location register (VLR) **120** which will validate the subscriber if his subscriber profile is already resident on remote visitor location register **120**. If the subscriber's profile is not yet resident on remote visitor location register **120**, then visitor location register **120** initiates a registration request to the subscriber's home location register **40** using the subscriber's supplied directory number and/or a system ID to locate home location register **40**. The subscriber's home location register **40** responds by forwarding his subscriber profile and authentication data. Remote visitor location register **120** stores the subscriber's home directory number, his assigned remote network IP address, and the directory number of the remote network central office gateway **130**. The subscriber's home location register **40**, in turn, stores the remote network's **100** central office gateway **130** directory number and/or IP address. Next, remote visitor location register **120** responds to remote gatekeeper **110** with the subscriber's profile and authentication information which is stored in remote

gatekeeper **110**. Where possible, standard *IS-41* or *GSM-MAP* protocols are used for communications among home location register nodes, visitor location register nodes, and gatekeeper nodes. The gatekeepers act as mobile switching centers (MSCs) with respect to *IS-41* or *GSM-MAP* protocols.

Call origination for a public network roaming call scenario is performed as follows. When the subscriber wishes to call someone while roaming on a remote network, he dials the called party's directory number. The remote gatekeeper **110**, recognizing that the subscriber's IP address is dynamically assigned, queries remote visitor location register **120** supplying the subscriber's assigned IP address. Remote visitor location register **120** sends back the subscriber's home directory number as well as authentication data needed to place the call. Remote gatekeeper **110** initiates an origination via remote central office gateway **130** and central office **140** by supplying the subscriber's home directory number as the calling party and the called party's directory number. The call routes normally over public switching telephone network **70** to the called party's central office **80**. Call origination may be optimized by duplicating the IP address to directory number mapping in the gatekeeper.

Call termination for a public network roaming call scenario is performed as follows. This time, the subscriber receives a call from someone while he is roaming in another network. The caller dials the subscriber's telephone directory number. The call routes normally over public switching telephone network **70** from the caller's serving central office **80** to the subscriber's home central office **60**. The subscriber's central office **60** queries its home location register **40** by supplying the subscriber's directory number. Home location

register **40** returns the directory number of the central office gateway **130** of the network **100** in which the subscriber is roaming. The subscriber's home central office **60** routes the call to the remote network central office **140** using the remote central office gateway **130** directory number and supplying the subscriber's home directory number and/or URL or electronic mail address. If the directory number only is supplied, remote central office **140** queries remote visitor location register **120** by supplying the subscriber's home directory number and retrieves the subscriber's remote assigned IP address. Remote central office **140** routes the call to remote central office gateway **130** by supplying the subscriber's dynamically assigned IP address. Lastly, remote central office gateway **130** uses the subscriber's IP address to route the call to the subscriber.

Private network roaming, illustrated in **FIGURE 3**, is achieved in almost identical fashion as public network roaming with the following exceptions. *IS-41/GSM-MAP* messages can be sent over a *virtual private network* (VPN) **160** instead of the *IS-41* or *GSM-MAP* public network **150**, thereby lowering costs. Second, the local gatekeeper can make least cost routing and/or quality of service decisions and choose to route a call over a public switching telephone network or a virtual private network.

FIGURES 4-9 illustrate method or process steps for various functions of the present invention. It is to be understood that each of the method or process steps illustrated herein are readily implementable by those of ordinary skill in the art as a computer program product having a medium with a computer program embodied thereon. The computer program product is

capable of being loaded and executed on the appropriate computer processing device(s) in order to carry out the method or process steps described.

FIGURE 4 illustrates the method or process steps for subscriber registration within the home area network. Once a subscriber connects 402 his IP telephone to his home IP network, registration is initiated and an IP address is assigned 404 to the IP phone. A registration initiation message is sent 406 to the IP network gatekeeper. The gatekeeper forwards 408 the registration information to the serving home location register (HLR) which validates the subscriber's service and authentication data. The home location register responds 410 with authentication data and subscriber profile data. At this point, the authentication data and subscriber profile data can be stored within the gatekeeper 412 or the network gateway directory number, IP phone directory number, and assigned IP address can be stored in the home location register 414.

FIGURE 5 illustrates the method or process steps for call origination for a subscriber within the home area network. Once a subscriber has registered his IP telephony device with his home area IP network, he may place or receive calls. To place a call (call origination), the subscriber dials and the gatekeeper sends 502 the IP address previously assigned during registration to the home location register. The home location register returns 504 the subscriber's directory number, authentication data and any other data needed to place the call to the gatekeeper. The subscriber's gatekeeper then originates 506 the call origination by supplying the subscriber's directory number as the calling party and called party's directory number to the central office gateway and

central office (CO) . The call routes 508 normally over a public switching telephone network (PSTN) to the called party's serving central office.

FIGURE 6 illustrates the method or process steps for call termination within the home area network. A caller dials the subscriber's telephone directory number. The call routes normally over the public switching telephone network from the caller's central office to the subscriber's central office 602. To retrieve the call (call termination), the subscriber's central office queries 604 home location register by supplying the subscriber's directory number and retrieves 606 the directory number of the subscriber's central office gateway and the IP address of the subscriber's IP phone. The subscriber's central office routes 608 the call to the subscriber's central office gateway by supplying the IP address of the subscriber's IP phone Lastly, the subscriber's central office gateway uses the subscriber's IP address to route 610 the call to the subscriber's IP telephone.

FIGURE 7 illustrates the method or process steps for subscriber registration while roaming on a remote area network. The subscriber initiates registration on a remote IP network by connecting 702 his IP phone to the remote IP network. The remote IP network initiates 704 contact via a registration request message with its gatekeeper in which the subscriber supplies his home area directory number. The remote gatekeeper receives the registration request and recognizes it as a non-local subscriber based on the supplied directory number. The remote gatekeeper then forwards 706 the request to a visitor location register (VLR). If the subscriber's profile is not yet resident on remote visitor location register then visitor location register initiates

708 a registration request to the subscriber's home location register using the subscriber's supplied directory number and/or a system ID to locate home location register. The subscriber's home location register responds 710 by forwarding his subscriber profile and authentication data. Remote visitor location register stores 712 the subscriber's home directory number, his assigned remote network IP address, and the directory number of the remote network central office gateway. The subscriber's home location register in turn, stores 714 the remote network's central office gateway directory number and/or IP address. Next, remote visitor location register responds 716 to remote gatekeeper with the subscriber's profile and authentication information which is stored 718 in the remote gatekeeper.

Otherwise, the visitor location register will validate 720 the subscriber since his subscriber profile is already resident on remote visitor location register. The visitor location register sends 722 the service profile and authentication data to the remote IP network gatekeeper where it is then stored 724.

FIGURE 8 illustrates the method or process steps for call origination while roaming on a remote area network. When the subscriber wishes to call someone while roaming on a remote network, he dials the called party's directory number. The remote gatekeeper recognizing that the subscriber's IP address is dynamically assigned, queries 802 remote visitor location register supplying the subscriber's assigned IP address. Remote visitor location register sends 804 back the subscriber's home directory number as well as authentication data needed to place the call. Remote gatekeeper initiates 806

an origination via remote central office gateway and central office by supplying the subscriber's home directory number as the calling party and the called party's directory number. The call routes 808 normally over public switching telephone network to the called party's central office.

FIGURE 9 illustrates the method or process steps for call termination while roaming on a remote area network. A caller dials the subscriber's telephone directory number. The call routes normally over public switching telephone network from the caller's serving central office to the subscriber's home central office 902. The subscriber's central office queries its home location register by supplying the subscriber's directory number. Home location register returns 904 the directory number of the central office gateway of the network in which the subscriber is roaming. The subscriber's home central office gateway routes 906 the call to the remote network central office gateway using the remote central office gateway directory number and supplying the subscriber's home directory number and/or URL or electronic mail address. If the directory number only is supplied, remote central office queries 908 remote visitor location register by supplying the subscriber's home directory number and retrieves 910 the subscriber's remote assigned IP address. Remote central office routes 912 the call to the subscriber via remote central office gateway by supplying the subscriber's dynamically assigned IP address.

Alternatively, the call can be routed 914 from the home network gateway to the remote network gateway using the IP address of the subscriber's IP phone rather than using the subscriber's directory number. Remote central

office would then routes 916 the call to the subscriber via remote central office gateway by supplying the subscriber's dynamically assigned IP address.

Appropriate computer program code in combination with hardware implements many of the elements of the present invention. This computer code is often stored on storage media. This media can be a diskette, hard disk, CD-ROM, or tape. The media can also be a memory storage device or collection of memory storage devices such as read-only memory (ROM) or random access memory (RAM). Additionally, the computer program code can be transferred to the appropriate hardware over some type of data network.

It is to be understood that the foregoing is illustrative of the present invention and is not to be construed as limited to the specific embodiments disclosed, and that modifications to the disclosed embodiments, as well as other embodiments, are intended to be included within the scope of the appended claims.

For instance, an ATM or other packet data network may be substituted for the IP network used throughout the foregoing description.

Further, E.164 directory numbers to an IP address is only one mapping that the present invention contemplates. Universal resource locator (URL) addresses, electronic mail addresses, etc... may be substituted for the IP address mapping.

Still further, gateway protocols are freely substitutable. The present invention has been described using the H.323 protocol. Other protocols, including, but not limited to, internet protocol device control (IPDC), simple

gateway control protocol (SGCP), and session initiation protocol (SIP) may also be implemented.

The invention is defined by the following claims, with equivalents of the claims to be included therein.

CLAIMS

What is claimed is:

1. A method of managing call origination for subscribers on a packet data telephony network to a third party on a different network, said packet data telephony network including home location register, gatekeeper, and gateway nodes, said method comprising the steps of:

(a) registering a packet data communication device with the home location register of a packet data network; and

(b) originating a call from the packet data communication device to a third party on a different network.

2. The method of claim 1 wherein said registering step comprises the steps of:

(a) connecting said packet data communication device to said packet data network wherein a packet data network address is assigned to said packet data communication device;

(b) sending a registration initiation message to said gatekeeper;

(c) forwarding said registration initiation message to said home location register for service profile and authentication data validation purposes;

(d) returning, from said home location register, service profile and authentication data to said gatekeeper;

(e) storing said service profile and authentication data in said gatekeeper; and

(f) storing, in the home location register, the directory number of the gateway, the directory number of the packet data communication device, and

the packet data address of the packet data communication device assigned during said connecting step.

3. The method of claim 2 wherein said originating step comprises the steps of:

(a) sending, from the gatekeeper, the packet data address of the packet data communication device in a query to the home location register;

(b) returning, from the home location register to the gatekeeper, the caller's directory number and authentication data;

(c) initiating, via said gatekeeper, an origination in which the caller's directory number and a third party's directory number are supplied to said gateway; and

(d) routing the call from said gateway to said third party's network.

4. The method of claim 1 in which the third party's network is a public switching telephone network.

5. The method of claim 1 in which the packet data network is an Internet Protocol (IP) network.

6. The method of claim 1 in which the packet data communication device is an Internet Protocol (IP) telephone.

7. A method of managing call termination for subscribers on a packet data telephony network with a third party on a different network, said packet data

telephony network including home location register, gatekeeper, and gateway nodes, said method comprising the steps of:

(a) registering a packet data communication device with the home location register of a packet data network; and

(b) terminating a call from the packet data communication device with a third party on a different network.

8. The method of claim 7 wherein said registering step comprises the steps of:

(a) connecting said packet data communication device to said packet data network wherein a packet data network address is assigned to said packet data communication device;

(b) sending a registration initiation message to said gatekeeper;

(c) forwarding said registration initiation message to said home location register for service profile and authentication data validation purposes;

(d) returning, from said home location register, service profile and authentication data to said gatekeeper; and;

(e) storing said service profile and authentication data in said gatekeeper.

9. The method of claim 8 wherein said terminating step comprises the steps of:

(a) receiving a call into the central office;

(b) sending the directory number from the central office to the home location register;

(c) returning the directory number of the gateway and the packet data address of the packet data communication device;

(d) routing the call to the gateway; and

(e) routing the call from the gateway to the packet data communication device.

10. The method of claim 7 wherein said registering step comprises the steps of:

(a) connecting said packet data communication device to said packet data network wherein a packet data network address is assigned to said packet data communication device;

(b) sending a registration initiation message to said gatekeeper;

(c) forwarding said registration initiation message to said home location register for service profile and authentication data validation purposes;

(d) returning, from said home location register, service profile and authentication data to said gatekeeper; and;

(e) storing, in the home location register, the directory number of the gateway, the directory number of the packet data communication device, and the packet data address of the packet data communication device assigned during said connecting step.

11. The method of claim 7 in which the third party's network is a public switching telephone network.

12. The method of claim 7 in which the packet data network is an Internet Protocol (IP) network.

13. The method of claim 7 in which the packet data communication device is an Internet Protocol (IP) telephone.

14. A method of public switching telephone network based roaming call origination for subscribers roaming in remote packet data networks that are communicable with the subscriber's home packet data network, wherein each packet data network includes a visitor location register, a home location register, a gatekeeper, and a gateway node, said method comprising the steps of:

(a) registering a packet data communication device on a remote packet data network; and

(b) originating a call from the packet data communication device on the remote network to a third party.

15. The method of claim 14 wherein said registering step comprises the steps of:

(a) connecting said packet data communication device to said remote packet data network wherein a packet data network address is assigned to said packet data communication device;

(b) having said remote network initiate a registration request with the remote gatekeeper by supplying the remote gatekeeper with the home directory number;

(c) forwarding said registration request from the remote gatekeeper, upon recognition of a non-local directory number, to the remote network visitor location register;

(d) forwarding the registration request to the home network home location register supplying the home directory number;

(e) returning, from the home network home location register to the remote network visitor location register, service profile and authentication data;

(f) storing, in the remote network visitor location register, the service profile and authentication data, the home network directory number, the packet data address assigned in said connecting step, and the remote network gateway directory number;

(g) storing, in the home network home location register, the directory number of the remote network gateway and the packet data network address assigned in said connecting step;

(h) sending, from the remote network visitor location register to the remote network gatekeeper, the service profile and authentication data; and

(i) storing, in the gatekeeper, the service profile and authentication data.

16. The method of claim 15 wherein said originating step comprises the steps of:

(a) having the remote network gatekeeper request the directory number from the remote network visitor location register by supplying the packet data network address assigned during said connecting step;

(b) returning, from the remote network visitor location register to the remote network gatekeeper, the home directory number and authentication data;

(c) initiating, via the remote network gatekeeper, a call through the remote network gateway by supplying the home directory number and the third party's directory number; and

(d) routing the call over a public switching telephone network to the third party.

17. The method of claim 14 in which the packet data network is an Internet Protocol (IP) network.

18. The method of claim 14 in which the packet data communication device is an Internet Protocol (IP) telephone.

19. The method of claim 14 wherein said registering step comprises the steps of:

(a) connecting said packet data communication device to said remote packet data network wherein a packet data network address is assigned to said packet data communication device;

(b) having said remote network initiate a registration request with the remote gatekeeper by supplying the remote gatekeeper with the home directory number;

(c) forwarding said registration request from the remote gatekeeper, upon recognition of a non-local directory number, to the remote network visitor location register;

(d) validating service profile and authentication data if the service profile and authentication data is currently registered on the remote network visitor location register;

(e) sending, from the remote network visitor location register to the remote network gatekeeper, the service profile and authentication data; and

(f) storing, in the remote network gatekeeper, the service profile and authentication data.

20. A method of public switching telephone network based roaming call termination for subscribers roaming in remote packet data networks that are communicable with the subscriber's home packet data network, wherein each packet data network includes a visitor location register, a home location register, a gatekeeper, and a gateway node, said method comprising the steps of:

(a) registering a packet data communication device on a remote packet data network; and

(b) terminating a call from the packet data communication device on the remote network with a third party.

21. The method of claim 20 wherein said registering step comprises the steps of:

(a) connecting said packet data communication device to said remote packet data network wherein a packet data network address is assigned to said packet data communication device;

(b) having said remote network initiate a registration request with the remote gatekeeper by supplying the remote gatekeeper with the home directory number;

(c) forwarding said registration request from the remote gatekeeper, upon recognition of a non-local directory number, to the remote network visitor location register;

(d) forwarding the registration request to the home network home location register supplying the home directory number;

(e) returning, from the home network home location register to the remote network visitor location register, the service profile and authentication data;

(f) storing, in the remote network visitor location register, the service profile and authentication data, the home network directory number, the packet data address assigned in said connecting step, and the remote network gateway directory number;

(g) storing, in the home network home location register, the directory number of the remote network gateway and the remote packet data network address assigned in said connecting step;

(h) sending, from the remote network visitor location register to the remote network gatekeeper, the service profile and authentication data; and

(i) storing, in the service profile and authentication data, the service profile and authentication data.

22. The method of claim 21 wherein said terminating step comprises the steps of:

(a) receiving a call over a public telephone switching network into the home network central office;

(b) querying the home network home location register by supplying the called party's directory number and retrieving the remote network's gateway directory number;

(c) routing the call from the home network gateway to the remote network gateway supplying the home directory number;

(d) supplying the remote network visitor location register with the called party's home directory number;

(e) retrieving from the remote network visitor location register the packet data network address assigned during said connecting step corresponding to the called party's home directory number;

(f) routing the call from the remote network gateway using the packet data network address assigned during said connecting step.

23. The method of claim 21 wherein said terminating step comprises the steps of:

(a) receiving a call over a public telephone switching network into the home network central office;

(b) querying the home network home location register by supplying the called party's directory number and retrieving the remote network's gateway directory number;

(c) routing the call from the home network gateway to the remote network gateway supplying the called party's remote packet data network address; and

(d) routing the call from the remote network gateway to the called party using the packet data network address assigned during said connecting step.

24. The method of claim 20 in which the packet data network is an Internet Protocol (IP) network.

25. The method of claim 20 in which the packet data communication device is an Internet Protocol (IP) telephone.

26. The method of claim 20 wherein said registering step comprises the steps of:

(a) connecting said packet data communication device to said remote packet data network wherein a packet data network address is assigned to said packet data communication device;

(b) having said remote network initiate a registration request with the remote gatekeeper by supplying the remote gatekeeper with the home directory number;

(c) forwarding said registration request from the remote gatekeeper, upon recognition of a non-local directory number, to the remote network visitor location register;

(d) validating service profile and authentication data if the service profile and authentication data is currently registered on the remote network visitor location register;

(e) sending, from the remote network visitor location register to the remote network gatekeeper, the service profile and authentication data; and

(f) storing, in the remote network gatekeeper, the service profile and authentication data.

27. A computer program product for managing calls between subscribers on a packet data telephony network and subscribers not on a packet data telephony network from the packet data telephony network subscriber's home area, wherein said packet data network includes a home location register, a gatekeeper, and a gateway node, the computer program product having a medium with a computer program embodied thereon, the computer program product comprising:

computer program code for registering a packet data communication device with the home location register of a packet data network;

computer program code for originating a call from the packet data communication device to a third party on a different network; and

computer program code for terminating a call from the packet data communication device to a third party on a different network.

28. The computer program product of claim 27 wherein said registering computer program code comprises:

computer program code for connecting said packet data communication device to said packet data network wherein a packet data network address is assigned to said packet data communication device;

computer program code for sending a registration initiation message to said gatekeeper;

computer program code for forwarding said registration initiation message to said home location register for service profile and authentication data validation purposes;

computer program code for returning, from said home location register, service profile and authentication data to said gatekeeper;

computer program code for storing said service profile and authentication data in said gatekeeper; and

computer program code for storing, in the home location register, the directory number of the gateway, the directory number of the packet data communication device, and the packet data address of the packet data communication device assigned during said connecting step.

29. The computer program product of claim 28 wherein said originating computer program code comprises:

computer program code for sending, from the gatekeeper, the packet data address of the packet data communication device in a query to the home location register;

computer program code for returning, from the home location register to the gatekeeper, the caller's directory number and authentication data;

computer program code for initiating, via said gatekeeper, an origination in which the caller's directory number and a third party's directory number are supplied to said gateway; and

computer program code for routing the call from said gateway to said third party's network.

30. The computer program product of claim 28 wherein said terminating computer program code comprises:

computer program code for sending the directory number from the central office to the home location register upon receipt of a call into the central office;

computer program code for returning the directory number of the gateway and the packet data address of the packet data communication device;

computer program code for routing the call to the gateway; and

computer program code for routing the call from the gateway to the packet data communication device.

31. A computer program product for managing calls between subscribers on a packet data telephony network and subscribers not on a packet data telephony network while the packet data telephony network subscriber is roaming outside the subscriber's home area on a remote packet data telephony network, wherein each packet data network includes a visitor location register, a home location register, a gatekeeper, and a gateway node, the computer program product having a medium with a computer program embodied thereon, the computer program product comprising:

computer program code for registering a packet data communication device on a remote packet data network;

computer program code for originating a call from the packet data communication device on the remote network to a third party; and

computer program code for terminating a call from the packet data communication device on the remote network to a third party.

32. The computer program product of claim 31 wherein said registering computer program code comprises:

computer program code for connecting said packet data communication device to said remote packet data network wherein a packet data network address is assigned to said packet data communication device;

computer program code for having said remote network initiate a registration request with the remote gatekeeper by supplying the remote gatekeeper with the home directory number;

computer program code for forwarding said registration request from the remote gatekeeper, upon recognition of a non-local directory number, to the remote network visitor location register;

computer program code for forwarding the registration request to the home network home location register supplying the home directory number;

computer program code for returning, from the home network home location register to the remote network visitor location register, service profile and authentication data;

computer program code for storing, in the remote network visitor location register, the service profile and authentication data, the home network directory number, the packet data address assigned in said connecting step, and the remote network gateway directory number;

computer program code for storing, in the home network home location register, the directory number of the remote network gateway and the packet data network address assigned in said connecting step;

computer program code for sending, from the remote network visitor location register to the remote network gatekeeper, the service profile and authentication data; and

computer program code for storing, in the gatekeeper, the service profile and authentication data.

33. The computer program product of claim 32 wherein said originating computer program code comprises:

computer program code for having the remote network gatekeeper request the directory number from the remote network visitor location register by supplying the packet data network address assigned during said connecting step;

computer program code for returning, from the remote network visitor location register to the remote network gatekeeper, the home directory number and authentication data;

computer program code for initiating, via the remote network gatekeeper, a call through the remote network gateway by supplying the home directory number and the third party's directory number; and

computer program code for routing the call over a public switching telephone network to the third party.

34. The computer program product of claim 32 wherein said terminating computer program code comprises:

computer program code for receiving a call over a public telephone switching network into the home network central office;

computer program code for querying the home network home location register by supplying the called party's directory number and retrieving the remote network's gateway directory number;

computer program code for routing the call from the home network gateway to the remote network gateway supplying the home directory number;

computer program code for supplying the remote network visitor location register with the called party's home directory number;

computer program code for retrieving from the remote network visitor location register the packet data network address assigned during said connecting step corresponding to the called party's home directory number;

computer program code for routing the call from the remote network gateway using the packet data network address assigned during said connecting step.

35. The method of claim 31 wherein said registering computer program code comprises:

computer program code for connecting said packet data communication device to said remote packet data network wherein a packet data network address is assigned to said packet data communication device;

computer program code for having said remote network initiate a registration request with the remote gatekeeper by supplying the remote gatekeeper with the home directory number;

computer program code for forwarding said registration request from the remote gatekeeper, upon recognition of a non-local directory number, to the remote network visitor location register;

computer program code for validating service profile and authentication data if the service profile and authentication data is currently registered on the remote network visitor location register;

computer program code for sending, from the remote network visitor location register to the remote network gatekeeper, the service profile and authentication data; and

computer program code for storing, in the remote network gatekeeper, the service profile and authentication data.

36. An apparatus for managing calls between subscribers on a packet data telephony network and subscribers not on a packet data telephony network from the packet data telephony network subscriber's home area, wherein said packet data network includes a home location register, a gatekeeper, and a gateway node, said apparatus comprising:

means for registering a packet data communication device with the home location register of a packet data network;

means for originating a call from the packet data communication device to a third party on a different network; and

means for terminating a call from the packet data communication device to a third party on a different network.

37. The apparatus of claim 36 wherein said registering means comprises:

means for connecting said packet data communication device to said packet data network wherein a packet data network address is assigned to said packet data communication device;

means for sending a registration initiation message to said gatekeeper;

means for forwarding said registration initiation message to said home location register for service profile and authentication data validation purposes;

means for returning, from said home location register, service profile and authentication data to said gatekeeper;

means for storing said service profile and authentication data in said gatekeeper; and

means for storing, in the home location register, the directory number of the gateway, the directory number of the packet data communication device, and the packet data address of the packet data communication device assigned during said connecting step.

38. The apparatus of claim 37 wherein said originating means comprises:

means for sending, from the gatekeeper, the packet data address of the packet data communication device in a query to the home location register;

means for returning, from the home location register to the gatekeeper, the caller's directory number and authentication data;

means for initiating, via said gatekeeper, an origination in which the caller's directory number and a third party's directory number are supplied to said gateway; and

means for routing the call from said gateway to said third party's network.

39. The apparatus of claim 37 wherein said terminating means comprises:

means for sending the directory number from the central office to the home location register upon receipt of a call into the central office;

means for returning the directory number of the gateway and the packet data address of the packet data communication device;

means for routing the call to the gateway; and

means for routing the call from the gateway to the packet data communication device.

40. An apparatus for managing calls between subscribers on a packet data telephony network and subscribers not on a packet data telephony network while the packet data telephony network subscriber is roaming outside the subscriber's home area on a remote packet data telephony network, wherein each packet data network includes a visitor location register, a home location register, a gatekeeper, and a gateway node, said apparatus comprising:

means for registering a packet data communication device on a remote packet data network;

means for originating a call from the packet data communication device on the remote network to a third party; and

means for terminating a call from the packet data communication device on the remote network to a third party.

41. The method of claim 40 wherein said registering means comprises:

means for connecting said packet data communication device to said remote packet data network wherein a packet data network address is assigned to said packet data communication device;

means for having said remote network initiate a registration request with the remote gatekeeper by supplying the remote gatekeeper with the home directory number;

means for forwarding said registration request from the remote gatekeeper, upon recognition of a non-local directory number, to the remote network visitor location register;

means for forwarding the registration request to the home network home location register supplying the home directory number;

means for returning, from the home network home location register to the remote network visitor location register, service profile and authentication data;

means for storing, in the remote network visitor location register, the service profile and authentication data, the home network directory number, the packet data address assigned in said connecting step, and the remote network gateway directory number;

means for storing, in the home network home location register, the directory number of the remote network gateway and the packet data network address assigned in said connecting step;

means for sending, from the remote network visitor location register to the remote network gatekeeper, the service profile and authentication data; and

means for storing, in the gatekeeper, the service profile and authentication data.

42. The method of claim 41 wherein said originating means comprises:

means for having the remote network gatekeeper request the directory number from the remote network visitor location register by supplying the packet data network address assigned during said connecting step;

means for returning, from the remote network visitor location register to the remote network gatekeeper, the home directory number and authentication data;

means for initiating, via the remote network gatekeeper, a call through the remote network gateway by supplying the home directory number and the third party's directory number; and

means for routing the call over a public switching telephone network to the third party.

43. The method of claim 41 wherein said terminating means comprises:

means for receiving a call over a public telephone switching network into the home network central office;

means for querying the home network home location register by supplying the called party's directory number and retrieving the remote network's gateway directory number;

means for routing the call from the home network gateway to the remote network gateway supplying the home directory number;

means for supplying the remote network visitor location register with the called party's home directory number;

means for retrieving from the remote network visitor location register the packet data network address assigned during said connecting step corresponding to the called party's home directory number;

means for routing the call from the remote network gateway using the packet data network address assigned during said connecting step.

44. The method of claim 40 wherein said registering means comprises:

means for connecting said packet data communication device to said remote packet data network wherein a packet data network address is assigned to said packet data communication device;

means for having said remote network initiate a registration request with the remote gatekeeper by supplying the remote gatekeeper with the home directory number;

means for forwarding said registration request from the remote gatekeeper, upon recognition of a non-local directory number, to the remote network visitor location register;

means for validating service profile and authentication data if the service profile and authentication data is currently registered on the remote network visitor location register;

means for sending, from the remote network visitor location register to the remote network gatekeeper, the service profile and authentication data; and

means for storing, in the remote network gatekeeper, the service profile and authentication data.

45. An system for managing calls on a packet data telephony network comprising:

a home location register having computer processing and memory means;

a gatekeeper having computer processing and memory means;

a central office switch point having computer processing and memory means; and

a central office gateway having computer processing and memory means,

wherein packet data communication devices are registered upon connection to said packet data telephony network and calls are originated and terminated on the packet data telephony network.

46. The system of claim 45 wherein said calls are communicable with a public switching telephone network (PSTN).

47. The system of claim 45 wherein said calls are communicable with a wireless telephone network.

48. The system of claim 45 wherein said packet data telephony network is an IP network.

49. The system of claim 45 wherein said packet data communication device is an IP phone.

50. An system for managing calls on a remote packet data telephony network comprising:

a home location register within a home network having computer processing and memory means;

a visitor location register within said remote network having computer processing and memory means communicable with said home location register;

a gatekeeper having computer processing and memory means;

a central office switch point having computer processing and memory means; and

a central office gateway having computer processing and memory means,

wherein packet data communication devices are registered on said remote packet data telephony network upon connection to said remote packet data telephony network after obtaining service profile and authentication data from said home location register and calls are originated and terminated on the remote packet data telephony network.

51. The system of claim 50 wherein said calls are communicable with a public switching telephone network (PSTN).

52. The system of claim 50 wherein said calls are communicable with a wireless telephone network.

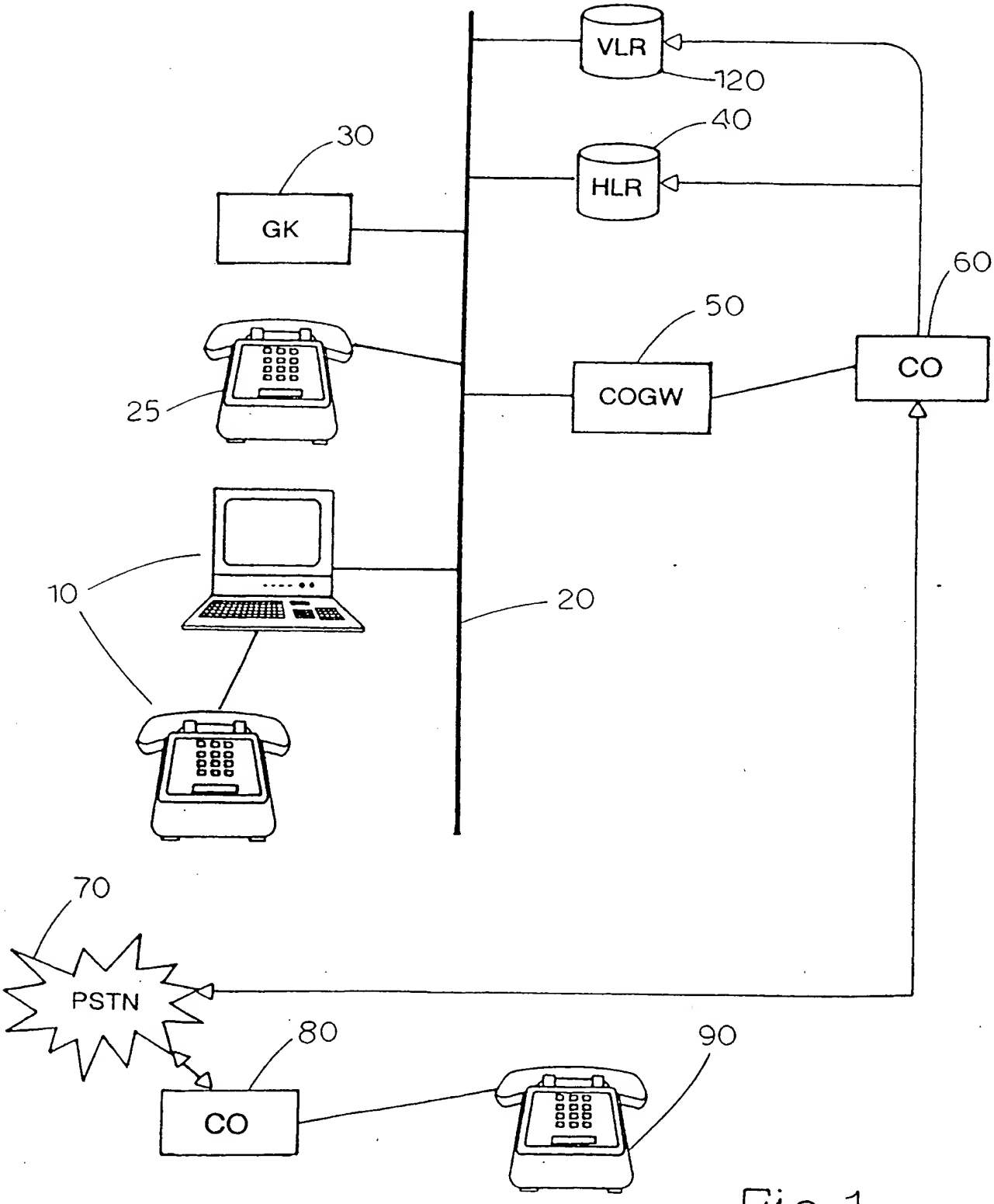


Fig. 1

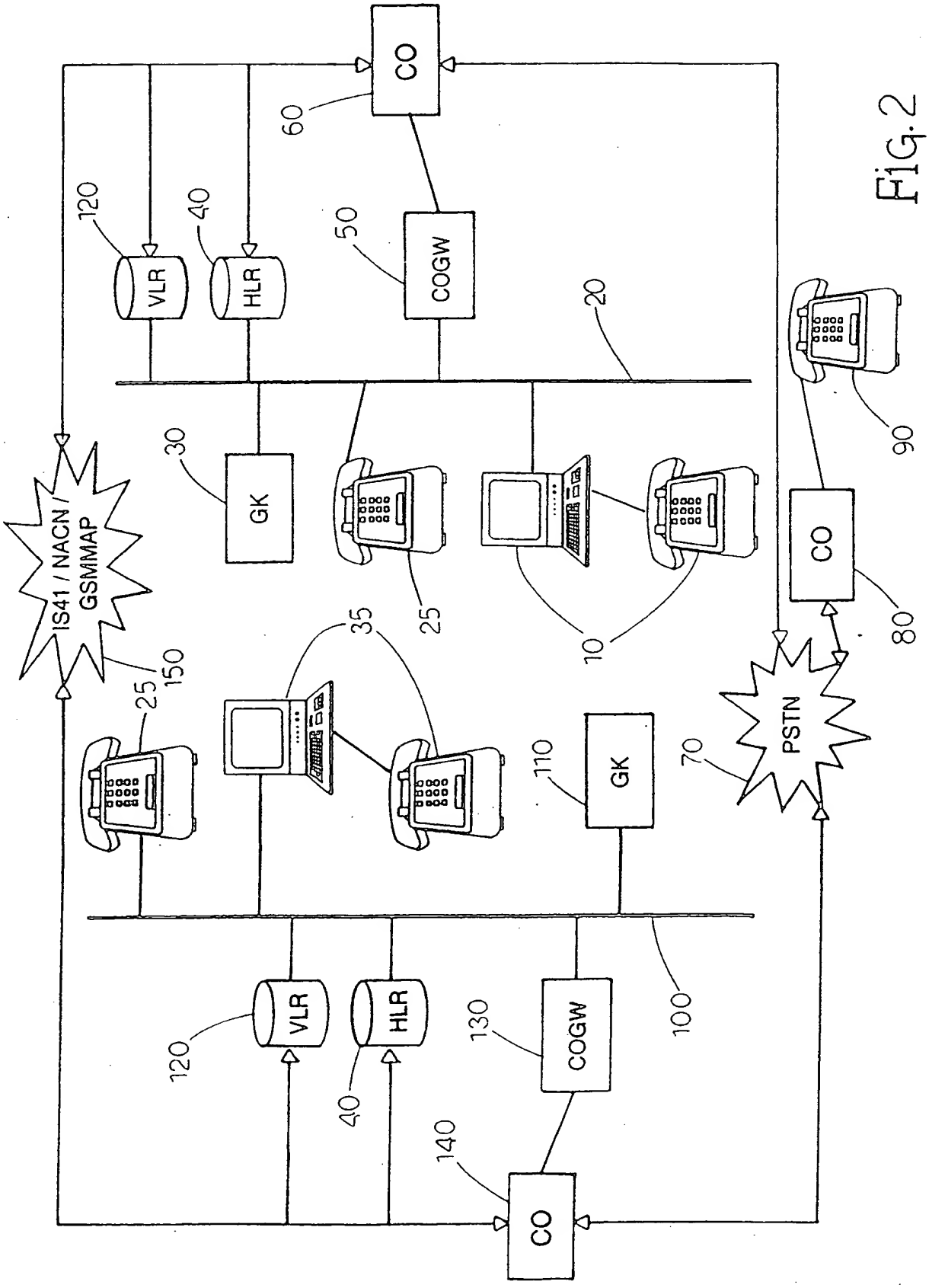
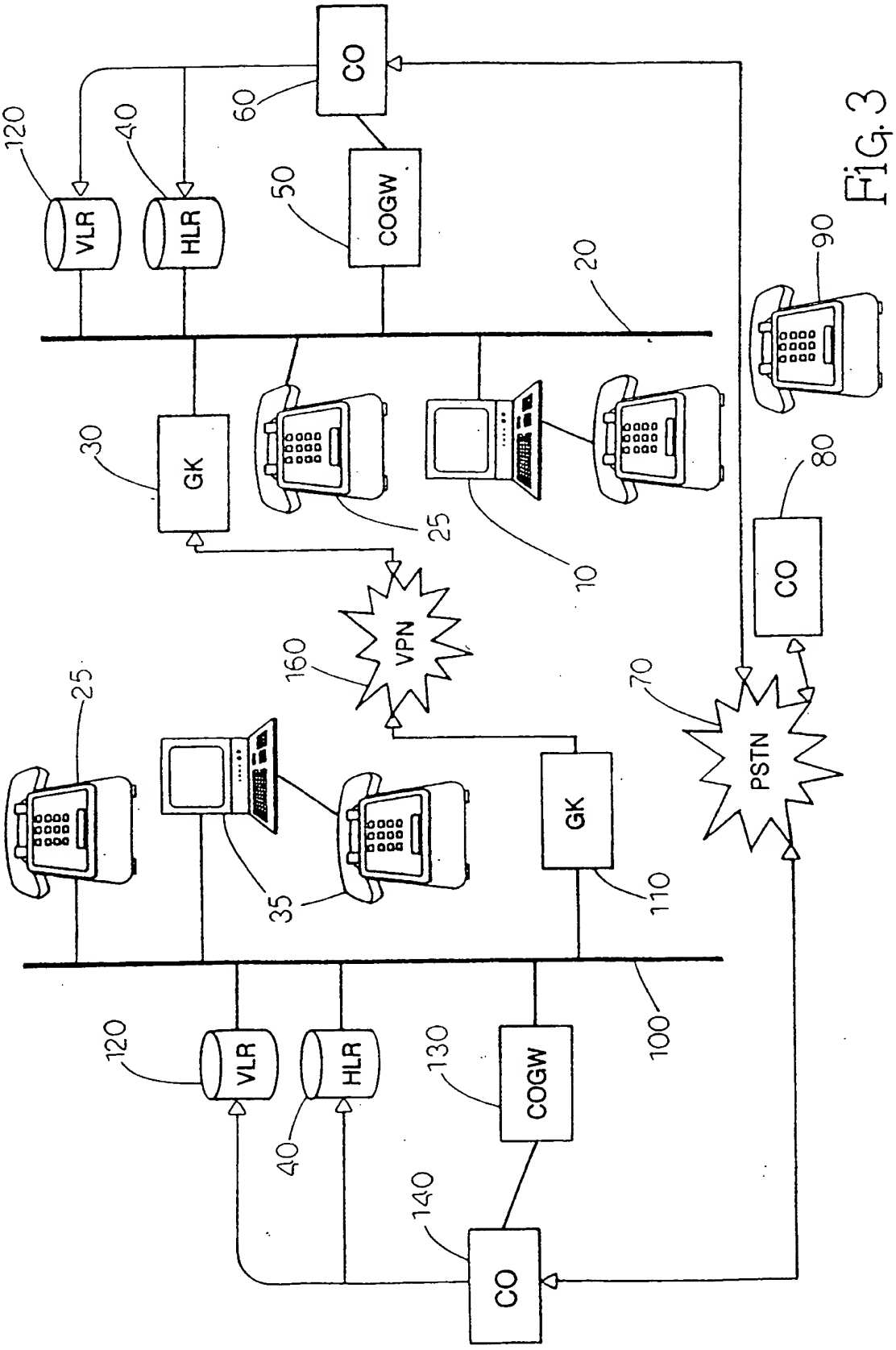

CO
60
VLR
120
HLR
40
COGW
50
20
GK
30
IS41 / NACN / GSMMAP
150
25
35
10
90
CO
80
PSTN
70
110
GK
120
VLR
HLR
40
130
COGW
100
140
CO

Fig. 2


CO
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HLR
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COGW
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90
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GK
25
10
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CO
VPN
160
70
PSTN
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GK
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100
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VLR
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COGW
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140
CO

Fig. 3

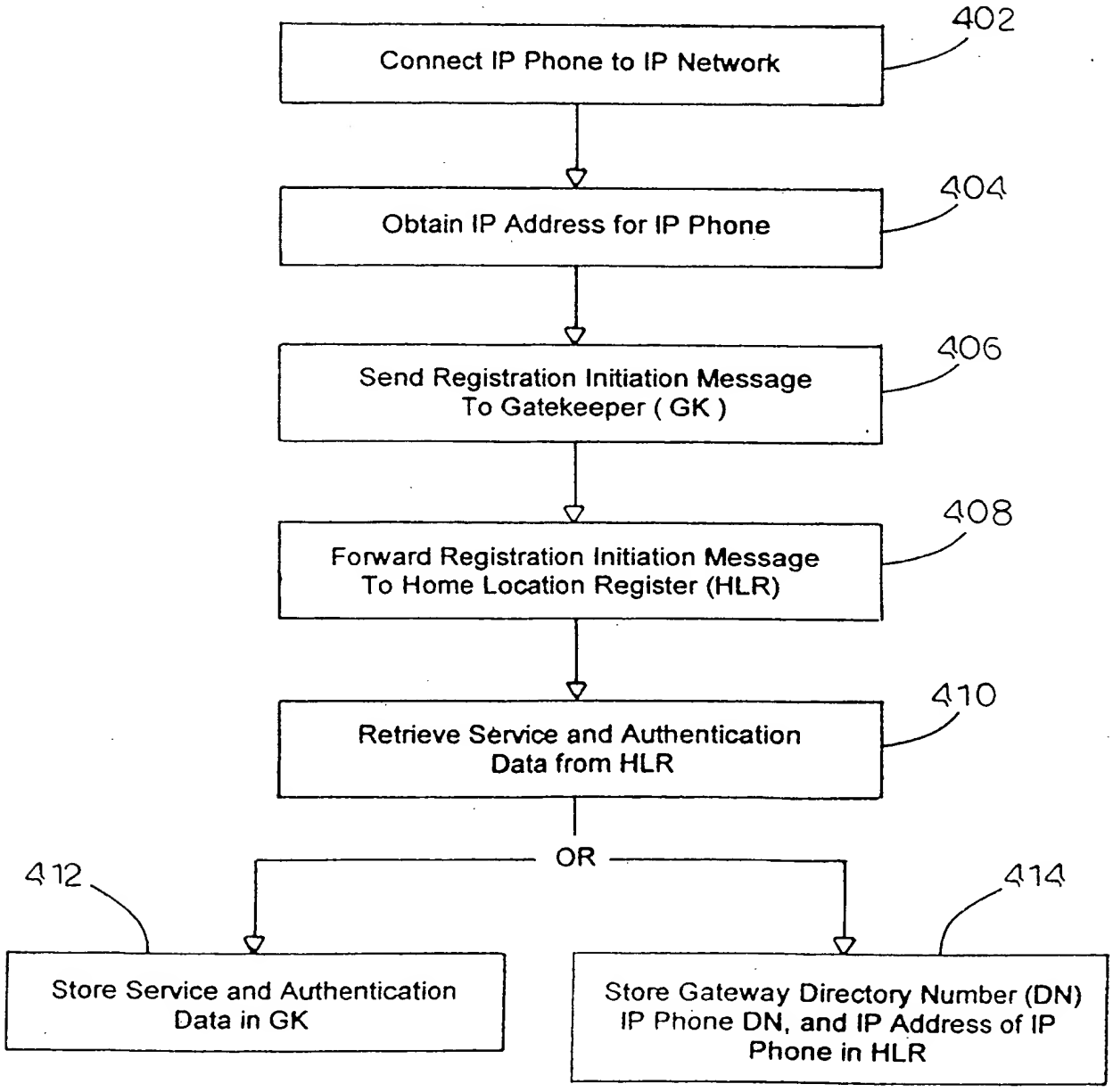
CALL REGISTRATION (HOME AREA)
Connect IP Phone to IP Network
402
Obtain IP Address for IP Phone
404
Send Registration Initiation Message To Gatekeeper (GK)
406
Forward Registration Initiation Message To Home Location Register (HLR)
408
Retrieve Service and Authentication Data from HLR
410
OR
412
Store Service and Authentication Data in GK
414
Store Gateway Directory Number (DN) IP Phone DN, and IP Address of IP Phone in HLR

Fig.4

CALL ORIGINATION (HOME AREA)

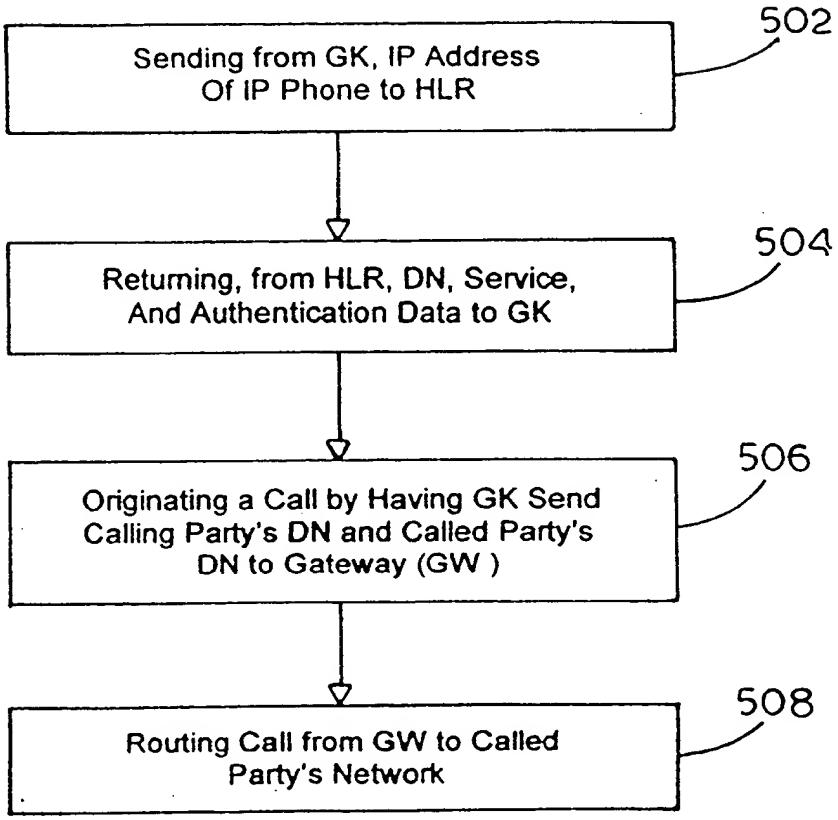

Fig.5

CALL TERMINATION (HOME AREA)

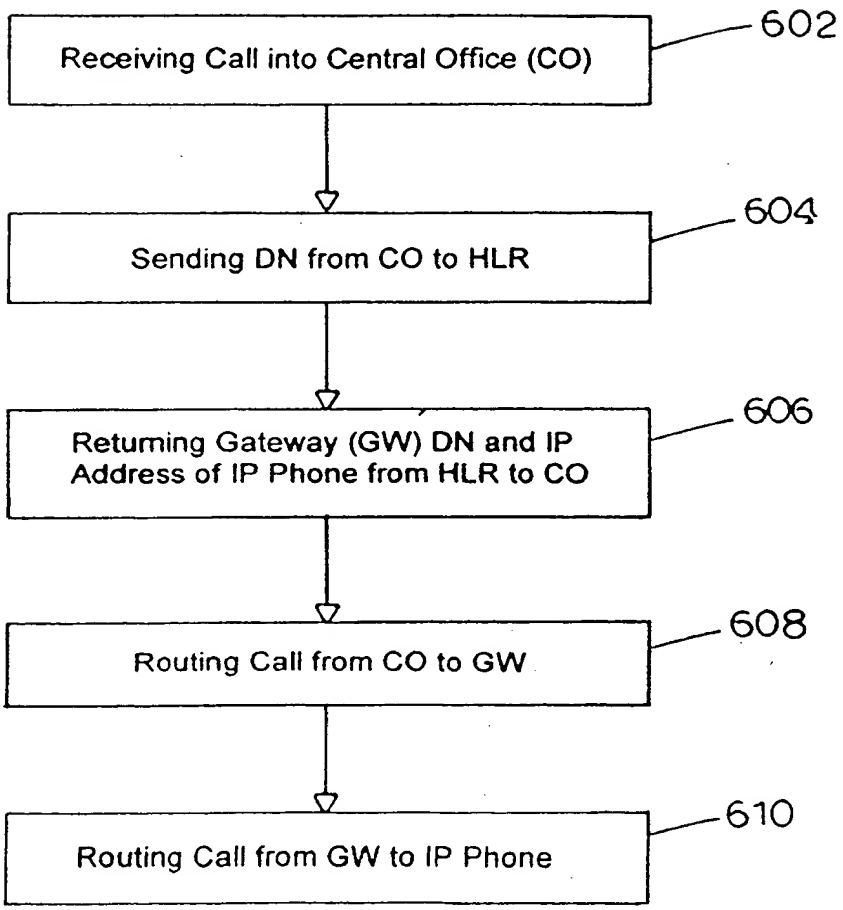

FIG.6

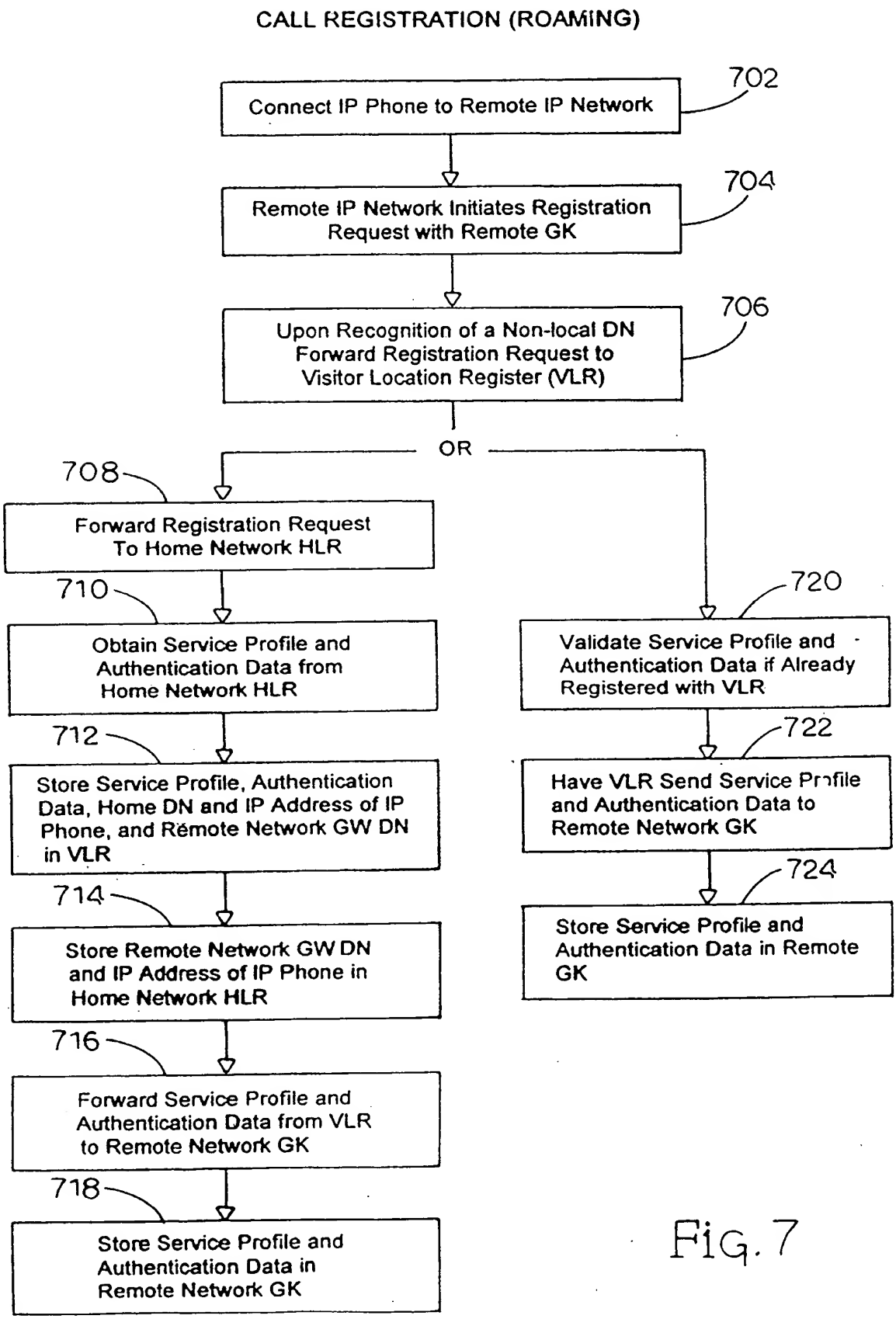
CALL REGISTRATION (ROAMING)
Connect IP Phone to Remote IP Network
702
Remote IP Network Initiates Registration Request with Remote GK
704
Upon Recognition of a Non-local DN Forward Registration Request to Visitor Location Register (VLR)
706
OR
708
Forward Registration Request To Home Network HLR
710
Obtain Service Profile and Authentication Data from Home Network HLR
712
Store Service Profile, Authentication Data, Home DN and IP Address of IP Phone, and Remote Network GW DN in VLR
714
Store Remote Network GW DN and IP Address of IP Phone in Home Network HLR
716
Forward Service Profile and Authentication Data from VLR to Remote Network GK
718
Store Service Profile and Authentication Data in Remote Network GK
720
Validate Service Profile and Authentication Data if Already Registered with VLR
722
Have VLR Send Service Profile and Authentication Data to Remote Network GK
724
Store Service Profile and Authentication Data in Remote GK

Fig. 7

CALL ORIGINATION (ROAMING)

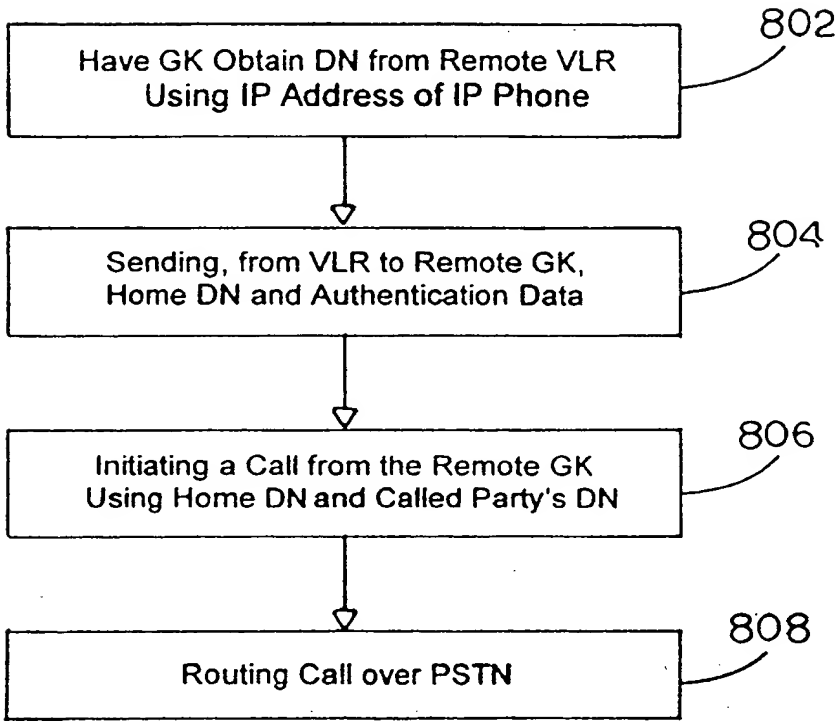

Fig.8

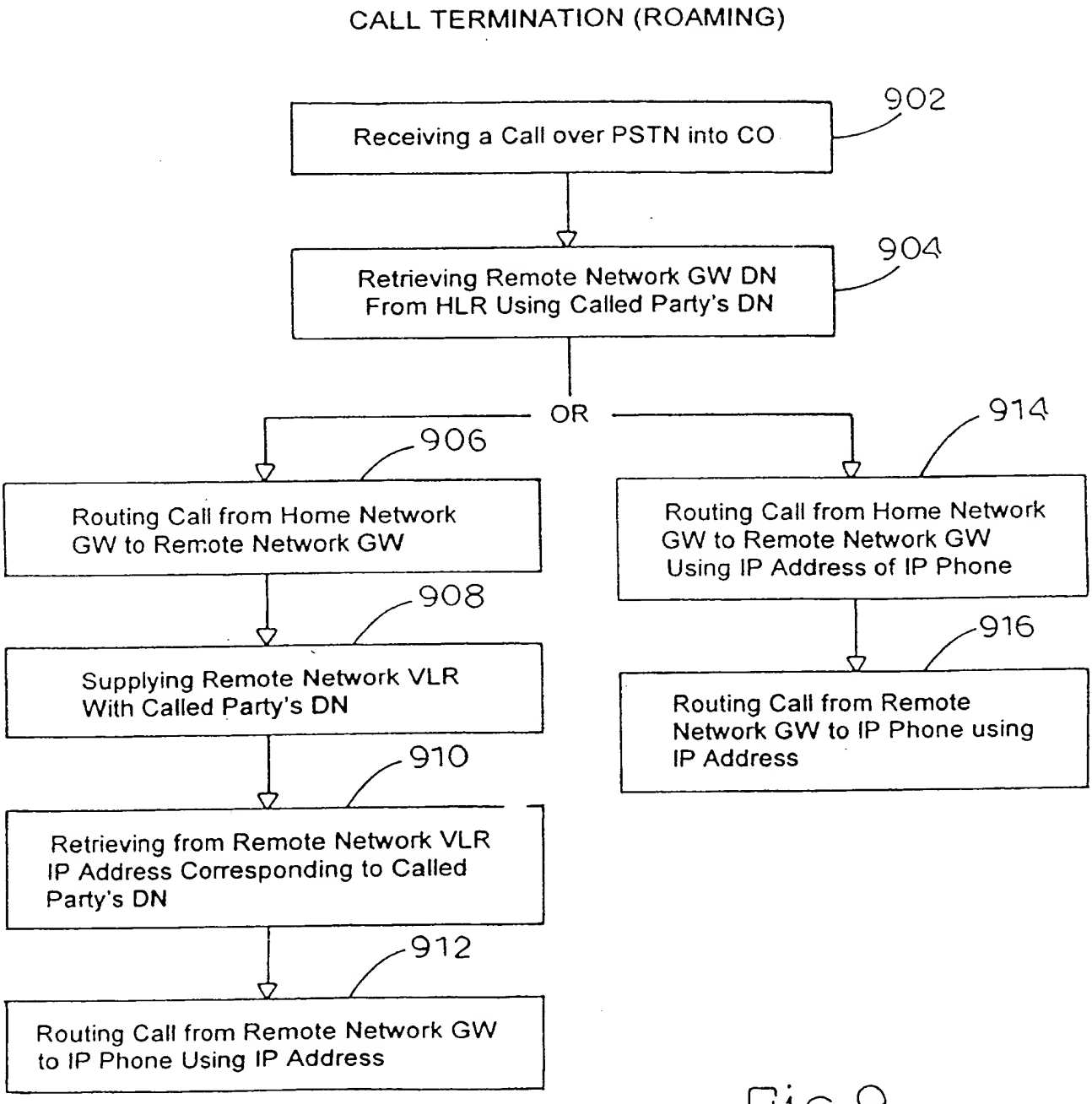
CALL TERMINATION (ROAMING)
Receiving a Call over PSTN into CO
902
Retrieving Remote Network GW DN From HLR Using Called Party's DN
904
OR
906
Routing Call from Home Network GW to Remote Network GW
908
Supplying Remote Network VLR With Called Party's DN
910
Retrieving from Remote Network VLR IP Address Corresponding to Called Party's DN
912
Routing Call from Remote Network GW to IP Phone Using IP Address
914
Routing Call from Home Network GW to Remote Network GW Using IP Address of IP Phone
916
Routing Call from Remote Network GW to IP Phone using IP Address

Fig.9

INTERNATIONAL SEARCH REPORT

Inter nal Application No
PCT/IB 99/01614

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04M7/00 H04L29/06

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04L H04M H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	HANSSON A ET AL: "PHONE DOUBLER - A STEP TOWARDS INTEGRATED INTERNET AND TELEPHONE COMMUNITIES" ERICSSON REVIEW,SE,ERICSSON. STOCKHOLM, no. 4, page 142-151 XP000725693 ISSN: 0014-0171	1-8, 10-13, 27-29, 36-38, 45-49
Y	page 144, left-hand column, paragraph 4 -right-hand column, paragraph 4 page 145, right-hand column, paragraph 2 - paragraph 4	9,30,39
A	page 147, paragraph 2 - paragraph 4	50-52

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
20 January 2000	31/01/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Blanco Cardona, P

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Inter nal Application No
PCT/IB 99/01614

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 96 38018 A (KOPONEN HARRI ;KAAKKOLA MATTI (FI); MELEN BJOERN (FI); VAEAENAENEN) 28 November 1996 (1996-11-28) abstract page 4, paragraph 2 page 5, line 2 - line 35 page 9, line 5 - line 21 page 12, paragraph 2 -page 13, paragraph 4	9,30,39
A	figure 1	2,10,28, 37

A	SCHOEN U ET AL: "CONVERGENCE BETWEEN PUBLIC SWITCHING AND THE INTERNET" ISS. WORLD TELECOMMUNICATIONS CONGRESS. (INTERNATIONAL SWITCHING SYMPOSIUM);CA,TORONTO, PINNACLE GROUP, page 549-560 XP000720563 abstract page 553, left-hand column, paragraph 2 -right-hand column, paragraph 3 page 560, left-hand column, paragraph 2 - paragraph 6 figure 4.1	45

X	GB 2 321 158 A (SAMSUNG ELECTRONICS CO LTD) 15 July 1998 (1998-07-15)	50-52
A	page 1, line 5 - line 11 page 2, line 19 -page 3, line 14 page 5, line 39 -page 6, line 13 page 7, line 5 -page 8, line 35 figure 3	14-26, 31-35, 40-44

A	MACKENZIE F: "THE CHALLENGE OF UNIVERSAL PERSONAL COMMUNICATIONS" BRITISH TELECOMMUNICATIONS ENGINEERING,GB,BRITISH TELECOMMUNICATIONS ENGINEERING. LONDON, vol. 16, no. 3, page 232-236 XP000724995 ISSN: 0262-401X page 232, right-hand column, paragraph 1 page 234, left-hand column, paragraph 3 page 235, left-hand column, paragraph 3 -right-hand column, paragraph 4	1-52

1

INTERNATIONAL SEARCH REPORT

...formation on patent family members

Interr ...al Application No
PCT/IB 99/01614

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9638018 A	28-11-1996	FI 961690 A	25-11-1996
		AU 708519 B	05-08-1999
		AU 5916696 A	11-12-1996
		BR 9609190 A	11-05-1999
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